July 27, 1965 F. A. LOEBEL 3,196,841

HEATER

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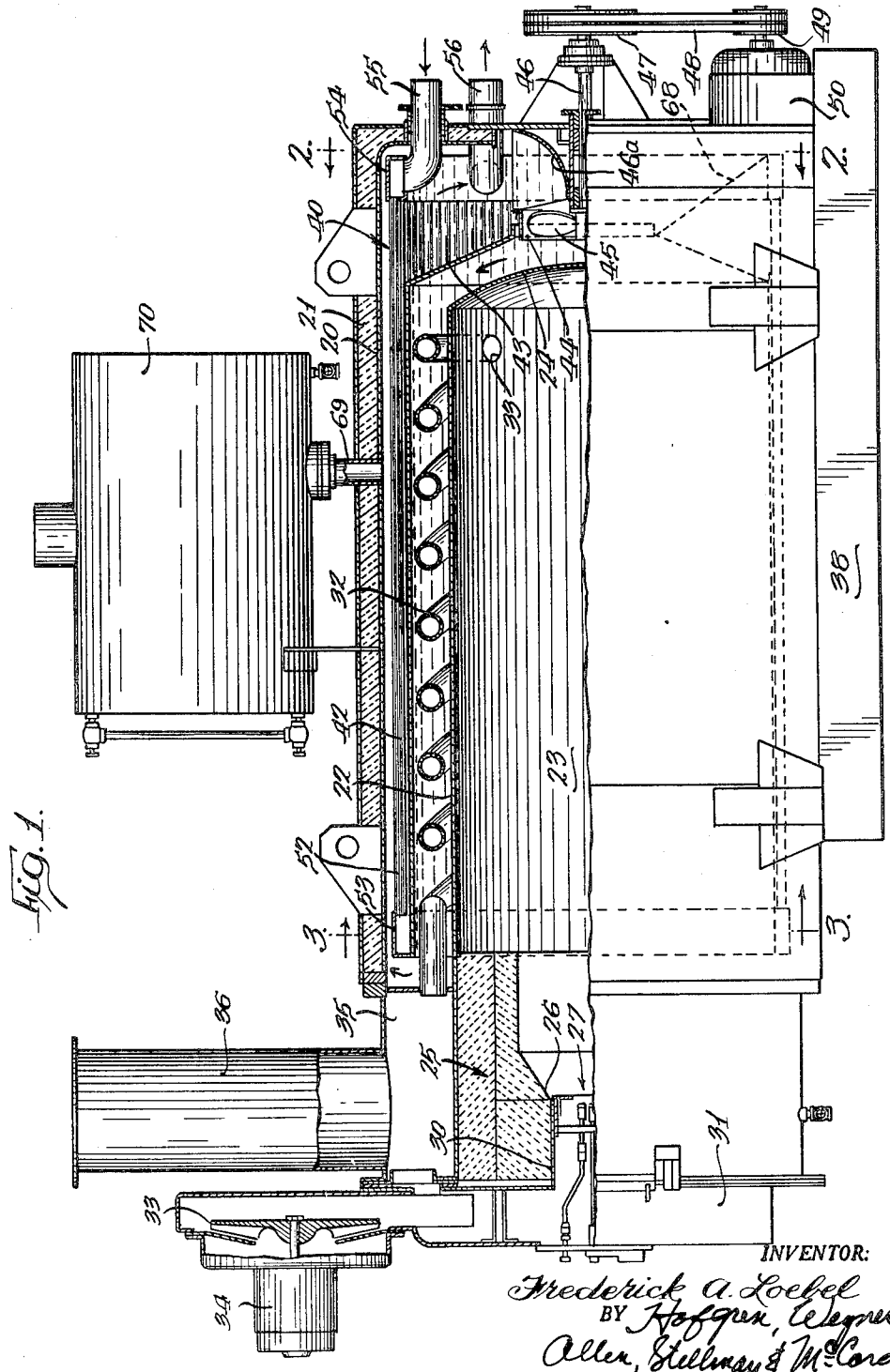


Fig. 1.

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Fig. 2.

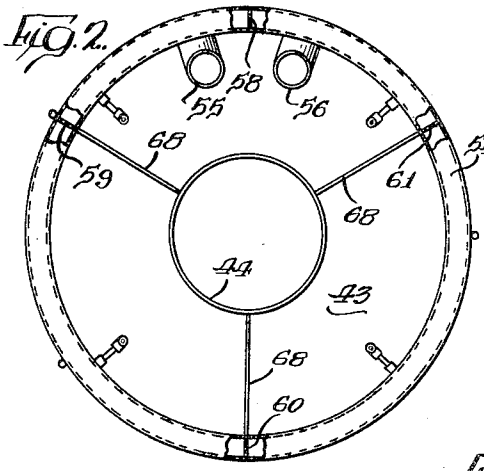


Fig. 3.

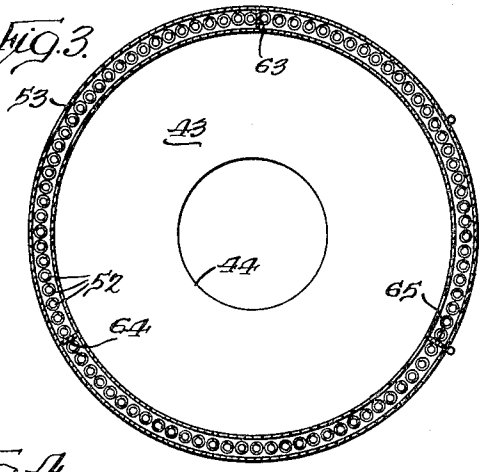


Fig. 4.

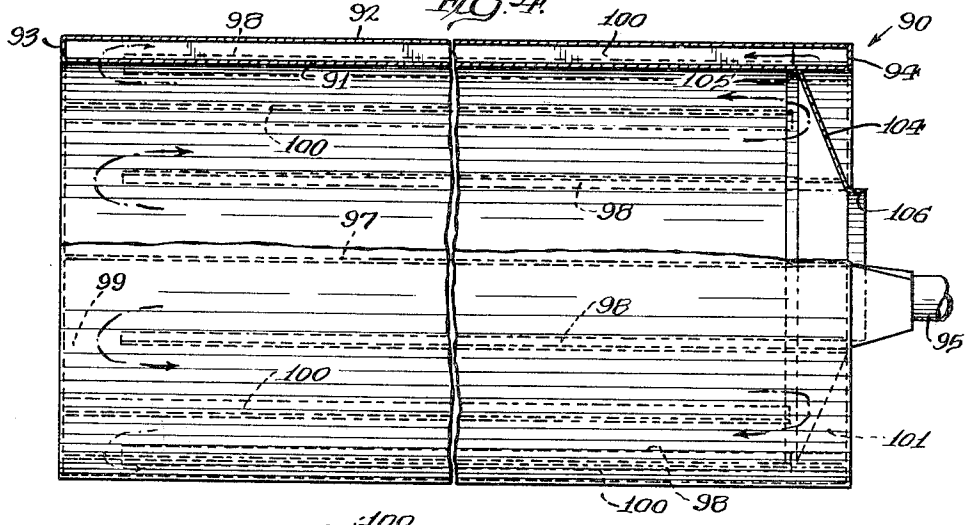
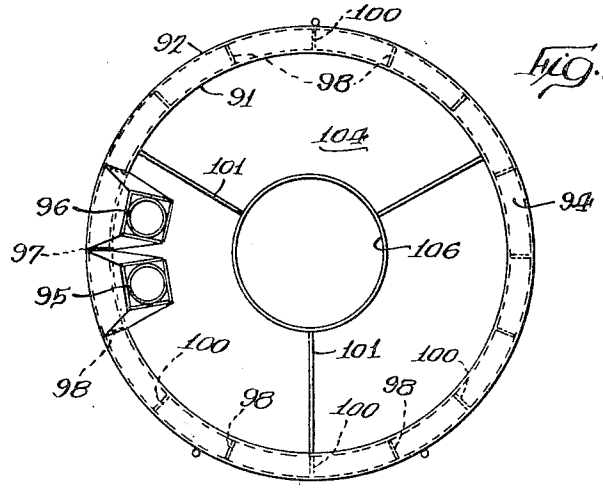


Fig. 5.



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Fig. 6.

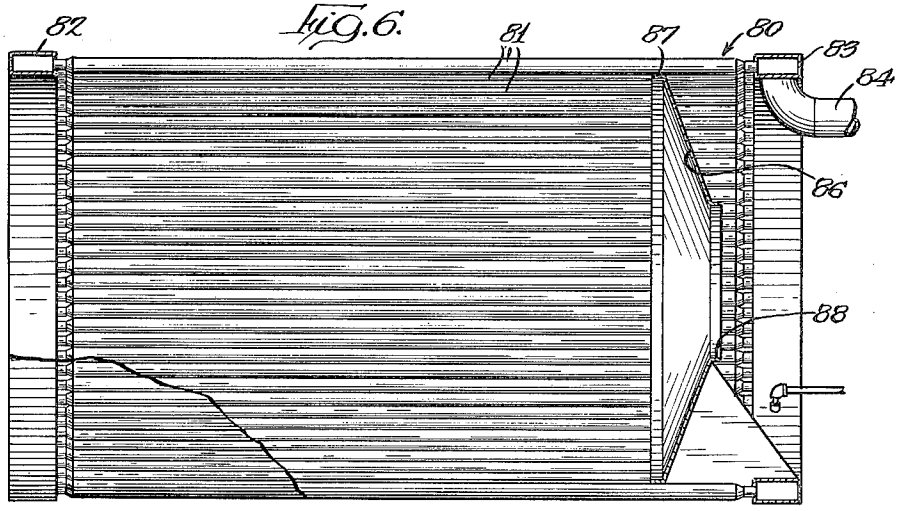


Fig. 7.

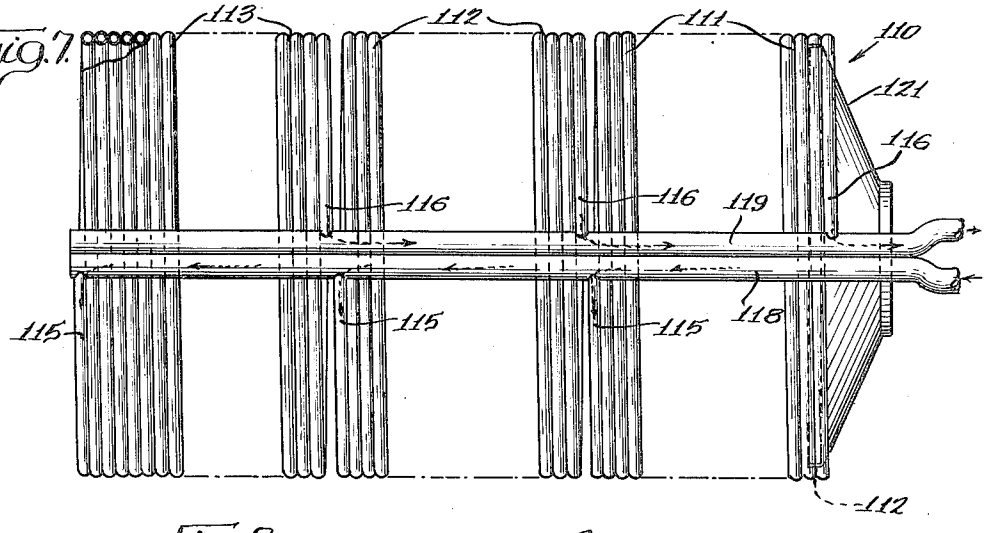


Fig. 8.

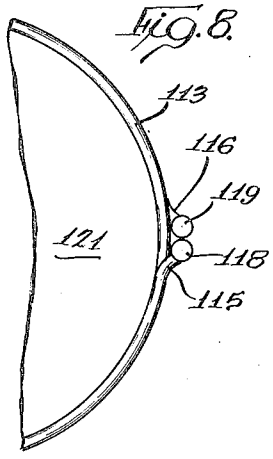
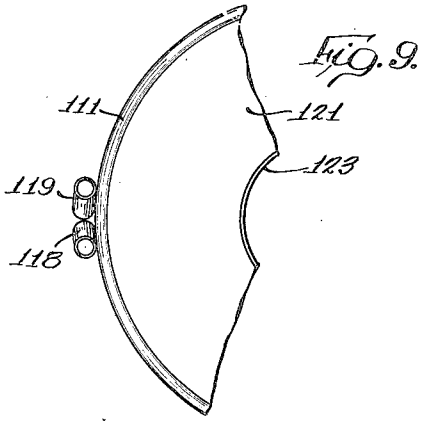


Fig. 9.



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Fig. 10.

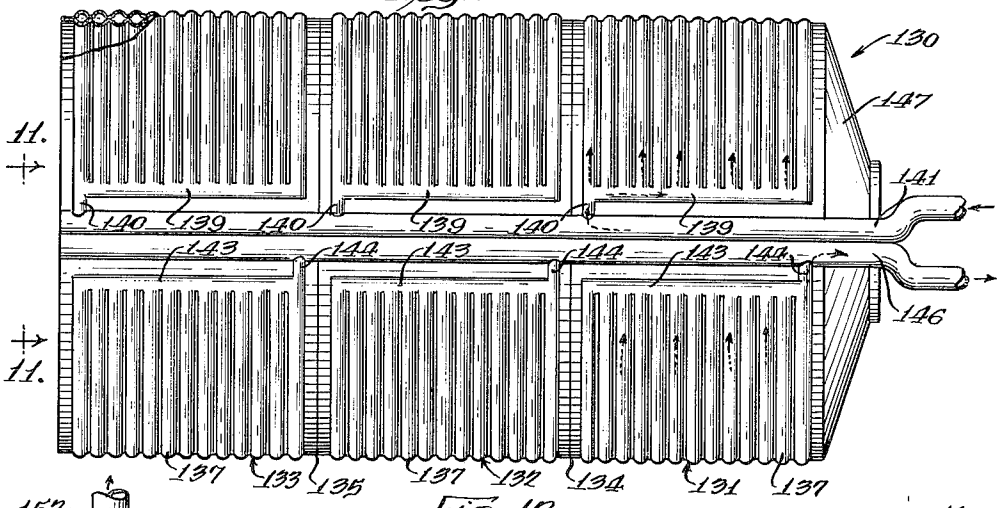


Fig. 12.

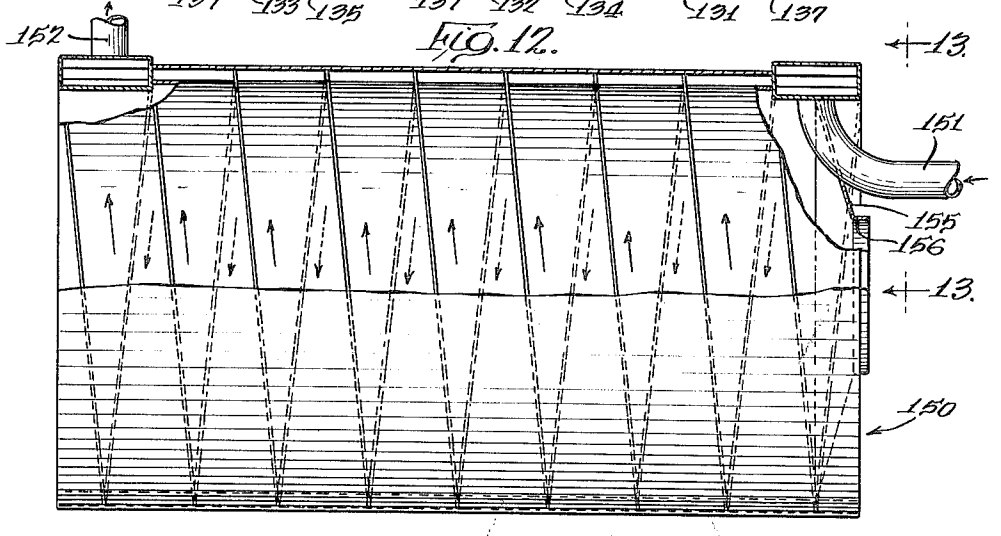


Fig. 11.

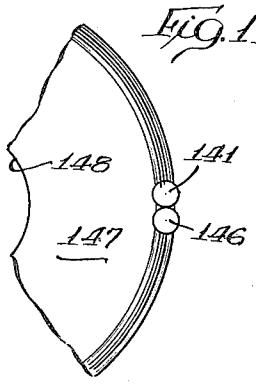
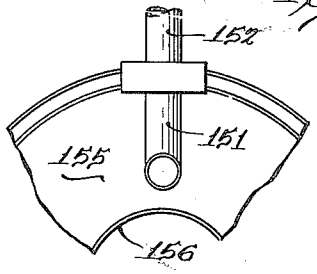


Fig. 13.



United States Patent Office 3,196,841 Patented July 27, 1965

3,196,841

HEATER

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Original application Oct. 13, 1960, Ser. No. 62,486, now Patent No. 3,111,935, dated Nov. 26, 1963. Divided and this application Apr. 10, 1963, Ser. No. 276,685
1 Claim. (Cl. 122—33)

This application is a division of application Serial No. 62,486, filed October 13, 1960, now Patent No. 3,111,935, dated November 26, 1963.

This invention relates to a heater for viscous fluids, such as asphalt, which tend to decompose when heated in direct fired heaters.

It is a general object of the invention to provide a new and improved heater of the type described.

A more specific object is to provide a new and improved heater of the type described including an outer shell, an inner furnace within the shell, heat exchanger conduit means disposed around the furnace in the space between the furnace and the shell for conducting fluid to be heated longitudinally and circumferentially through the shell, and means for circulating heat transfer liquid in a predetermined path in the shell in heat transfer relationship with the furnace and the conduit means.

Another object is to provide a new and improved heater of the type described including a hot gas flue connected with the furnace adjacent one end thereof, encircling the furnace spirally and connected with an exhaust opening.

A further object is to provide a new and improved heater of the type described, including baffle means associated with the heat exchanger conduit means providing a predetermined path for circulation of the heat transfer liquid, and impeller means for circulating the liquid.

It is also an object of the invention to provide a new and improved heater of the character mentioned including a heat exchanger in the form of a combined conduit means and baffle means in which the conduit means provides for circulation of the fluid to be heated longitudinally and circumferentially through the shell, and the baffle means defines a predetermined path for circulation of heat transfer liquid in heat exchange relationship with the furnace and the conduits.

Other objects and advantages will become readily apparent from the following detailed description taken in connection with the accompanying drawings, in which:

FIG. 1 is a side elevational view, partly in section, illustrating a heater embodying the principles of the present invention;

FIG. 2 is a fragmentary sectional view taken at about the line 2—2 of FIG. 1;

FIG. 3 is a fragmentary sectional view taken at about the line 3—3 of FIG. 1;

FIG. 4 is an elevational view, partly in section, showing an alternative heat exchanger structure which may be utilized in the heater of FIG. 1 in lieu of that illustrated in FIG. 1;

FIG. 5 is an end elevational view of the structure shown in FIG. 4;

FIG. 6 is an elevational view, partly in section, of another embodiment of the heat exchanger;

FIG. 7 is an elevational, partly in section, view of another embodiment of heat exchanger;

FIG. 8 is a fragmentary left end elevational view of the structure illustrated in FIG. 7;

FIG. 9 is a fragmentary right-end elevational view of the structure illustrated in FIG. 7;

FIG. 10 is an elevational view, partly in section, of another embodiment of heat exchanger;

FIG. 11 is a fragmentary left-end elevational view of the structure illustrated in FIG. 10;

FIG. 12 is an elevational view, partly in section, of another embodiment of heat exchanger; and

FIG. 13 is a fragmentary right hand elevational view of the structure illustrated in FIG. 12.

While illustrative embodiments of the invention are shown in the drawings and will be described in detail herein, the invention is susceptible of embodiment in many different forms, and it should be understood that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiments illustrated. The scope of the invention will be pointed out in the appended claims.

The purpose of the apparatus of this invention is to heat viscous fluids which tend to decompose when heated in direct fired heaters. Decomposition results when the fluid remains in contact, even for short periods of time, with extremely hot metal, such as the metal surfaces of a fire tube or combustion chamber and hot gas flues. The present heater is designed specifically for heating asphalt, though the principles of the invention are not limited to this utility. Use is made of oil as an intermediate heat transfer fluid. The heat transfer oil is circulated over the metal surfaces of the combustion chamber and hot gas flue preferably at velocities exceeding 3 feet per second in order to control the heat exchange. The oil is preferably circulated by means of a propeller type pump, to also contact conduit means providing a tortuous path for conducting the fluid to be heated, such as asphalt, through the heater.

Referring to the drawings in greater detail, and particularly FIG. 1, the heater preferably includes an outer shell 20 which may be cylindrical and which may be insulated as illustrated at 21. Centrally disposed within the shell 20 is a cylindrical furnace as at 22 spaced from the walls of the outer shell and providing a combustion chamber 23. At the right end as viewed in FIG. 1, the furnace is closed by an end wall 24, and at the left end is provided with refractory material as shown at 25. The refractory material is formed with a centrally disposed opening as at 26 in which there is positioned a burner structure 27. The burner structure may be properly provided with fuel supply and ignition control means in any conventional or other suitable manner. A burner tube 30 in which the burner structure is positioned, opens at the left end into a hollow end cap or closure member 31 to which combustion air is supplied by means of a fan as at 33 suitably driven by a motor as at 34. The insulated outer shell may be suitably supported on skids or the like as illustrated at 38.

The products of combustion pass from the combustion chamber 23 to a hot gas flue 32 connected to the furnace as at 33, adjacent the right end thereof, spirally encircling the furnace toward the left end and opening to a chamber 35 having an exhaust opening in communication with an exhaust stack as at 36.

Positioned concentrically around the cylindrical furnace 22, in spaced relation between the furnace and the shell 20, is a heat exchanger generally designated 40 preferably in the form of a combined conduit means and baffle means, the conduit means for conducing the fluid to be heated, such as asphalt, in tortuous paths longitudinally and circumferentially through the heater, and the baffle means providing a determined path for circulation of heat exchange liquid through the heater in heat exchange relationship with the furnace 22, the flue 32 and the conduit means for the fluid to be heated. In the embodiment of FIGS. 1, 2 and 3, the heat exchanger includes a cylindrical baffle 42 concentric around the furnace 22 and spaced between the furnace and the

outer shell 20. Adjacent the right end as viewed in FIG. 1, the member 42 has secured thereto an annular frusto-conic closure member as at 43 provided with a central opening as 44. The members 42 and 43, secured together suitably as by welding, may be supported in the outer shell 20 by any suitable means.

A propeller or impeller 45 is positioned in the central opening 44 and secured on a drive shaft 46 so that when rotated, heat transfer fluid is drawn into the propeller from the right end of the heater through a guide means 46*a* and pumped or propelled outwardly toward the left as viewed in FIG. 1. The pump drive shaft 46 may be provided with suitable pulley means as at 47 connected by belt means 48 to pulley means 49 on the shaft of a drive motor 50. Provision is thus made for circulation of the heat transfer liquid in a predetermined path determined by the baffle members 42 and 43, including movement of the heat transfer liquid to the left as viewed in FIG. 1, through the annular space between the furnace 22 and the cylindrical baffle 42, in heat exchange relationship with the furnace 22 and the spiral hot gas flue 32. At the left end of the heater, the heat transfer liquid passes radially outwardly around the cylindrical baffle and toward the right end of the heater, in heat exchange relationship with the tubes for conducting asphalt through the heater, and back to the pump 45.

In the embodiment of FIGS. 1, 2 and 3, an annular series of horizontally disposed tubes 52 is arranged concentrically around the cylindrical baffle 42. Opposite ends of the tubes 52 are connected respectively to headers or manifolds 53 and 54, in the form of annular tubular elements of rectangular cross section. An inlet fitting 55 and an outlet fitting 56 communicate with the header 54.

Baffles or dividers are positioned in the header 54 at angularly spaced positions as illustrated at 58, 59, 60 and 61. In the header 53, baffles are positioned as illustrated at 63, 64 and 65. This effectively divides the tubes 52 into six angularly spaced groups, so that fluid from the inlet 55 flows back and forth in the tubes in a tortuous path to the outlet 56, flowing longitudinally to the left in FIG. 1 through three groups of tubes and longitudinally toward the right in FIG. 1 through three groups of tubes. It will be understood that the adjacent inlet 55 and outlet 56 are separated by the baffles 58 and 63. The first group of tubes is positioned between the baffles 58 and 59, the fluid flowing to the left in FIG. 1 through this group of tubes. The second group of tubes is positioned between the baffle 59 in the header 54 and the baffle 65 in the header 53, the fluid flowing toward the right in FIG. 1 through this group of tubes. The third group of tubes occurs between the baffle 65 and the header 53 and the baffle 60 in the header 54, the fluid flowing toward the left in FIG. 1 through this group of tubes. Continuing in this fashion, it will be understood that the fluid to be heated makes six passes back and forth longitudinally through the heater and circumferentially around the annular series of tubes to the outlet 56, while at the same time heat transfer oil is circulated through the shell 20 in heat exchange relationship with the furnace, the flue 32 and the tubes 52.

The header 54 and the annular closure member 43 may be relatively braced by angularly spaced braces in the form of triangular plates as at 68 suitably secured to both the closure member and the header as by welding, for example.

In order to provide for expansion of the heat exchange liquid in the shell 20 during operation of the burner, the chamber within the shell 20 is connected by a conduit 69 to an expansion tank 70 suitably supported above the insulated shell 20.

The heat exchangers illustrated in FIGS. 4–13 are each adapted for use in lieu of that illustrated at 40 in FIGS. 1, 2 and 3. In the modification of FIG. 6, the heat exchanger 80 is similar to that in FIGS. 1, 2 and 3 in that it includes a plurality of tubes as at 81 arranged in an annular series adapted to be positioned concentrically about the furnace 22. At opposite ends, headers 82 and 83 are connected respectively to the adjacent tube ends. Suitable inlet and outlet fittings communicate with the header 83, one being illustrated at 84. In lieu of the cylindrical baffle member 42 illustrated in the embodiment of FIGS. 1, 2 and 3, the tubes 81 include enlarged midportions of substantial length, abutting each adjacent tube in order to prevent flow of heat transfer liquid between the tubes, so that the series of tubes effectively provides a baffle similar to that at 42 in FIG. 1. Opposite ends of the tubes 81 include reduced portions adapted to the suitably joined to the headers 82 and 83. An annular frusto-conic baffle as at 86 includes an outer peripheral flange 87 suitably joined to the series of tubes 81, as by welding, and includes a central opening 88 in which the pump is adapted to be positioned to provide for circulation of heat transfer liquid in the manner described in connection with the embodiment of FIGS. 1, 2 and 3. Headers 82 and 83 include baffle members as described in connection with the headers 53 and 54 in the embodiment of FIGS. 1, 2 and 3.

FIGS. 4 and 5 illustrate a more economical heat exchanger 90 in the form of a pair of cylindrical concentric spaced members 91 and 92, and annular end closure members 93 and 94 sealing opposite ends of the annular space between the members 91 and 92. At the right end as viewed in FIG. 4, an inlet fitting 95 and an outlet fitting 96 communicate with the space between the cylindrical members 91 and 92. At angularly spaced positions, radially disposed dividers or baffles are positioned between the members 91 and 92 to provide a tortuous path for fluid to flow from the inlet 95 to the outlet 96, longitudinally back and forth through the heat exchanger and circumferentially therearound.

Between the inlet 95 and the outlet 96 a divider plate 97 extends for the entire length of the cylindrical members 91 and 92, effectively separating the inlet from the outlet. Continuing in a counterclockwise direction as viewed in FIG. 5 from the radially disposed divider or baffle 97, the remaining baffles are of less length than the total length of the members 91 and 92, and alternate baffles as at 98 have right ends (FIG. 4) abutting the end closure member 94, leaving openings 99 at the opposite end and intervening baffles as at 100 have their left ends flush with the closure member 93, leaving openings as at 101 at the opposite end. It will be understood that this arrangement of baffles between the concentric cylindrical members 91 and 92 provides a tortuous flow path for the fluid to be heated longitudinally back and forth through the heat exchanger and circumferentially around the heat exchanger to the outlet 96, as illustrated by the arrows shown in FIG. 4.

At the right end as viewed in FIG. 4, an annular, frusto-conic baffle or closure member 104 has an outer peripheral flange 105 welded to the inner cylindrical member 91 and includes a central opening as at 106 in which the pump may be positioned for circulating heat exchange fluid in the manner described in connection with the embodiment of FIGS. 1, 2 and 3.

In FIG. 7, the heat exchanger 110 comprises a series of coiled tubes, three as illustrated at 111, 112, and 113, in coils arranged end to end and with adjacent turns in each coil abutting. This effectively provides a cylindrical baffle comparable to that illustrated at 42 in FIG. 1. Each of the coils 111, 112, and 113 includes an inlet end as at 115 and an outlet end as at 116. The inlet ends 115 communicate with an inlet conduit or manifold 118, and the outlet ends communicate with an outlet conduit or manifold 119. The inlet and outlet manifolds are adapted to communicate respectively with inlet and outlet fittings similar to those shown at 55 and 56 in FIG. 1. Thus, fluid to be heated, such as asphalt, may be admitted through the inlet conduit 118, pass to the inlet ends 115,

then respectively through the coils **111**, **112** and **113** and to the outlet ends **116** to discharge through the outlet conduit **119**.

An annular frusto-conic baffle **121** has an outer peripheral flange **122** secured to the coil **111** and is formed with a central opening as at **123** in which a pump may be positioned for circulating the heat transfer liquid as in the previous modifications.

In the modification of FIGS. 10 and 11, a heat exchanger **130** comprises a plurality of tube groups as at **131**, **132** and **133** arranged end to end as at **134** and **135**, each group including a plurality of parallel tubes as at **137** arcuately bent and adapted to encircle the furnace **22** concentrically. Each group of tubes includes an inlet manifold as at **139** communicating with inlet ends of the tubes and also connected as at **140** with an inlet conduit **141**. Each group of tubes also includes an outlet manifold as at **143** communicating with outlet ends of the tubes and connected as at **144** with an outlet conduit **146**. The inlet and outlet conduits **141** and **146** are adapted for connection with inlet and outlet fittings as illustrated at **55** and **56** in FIG. 1. At the right end as viewed in FIG. 10, an annular closure member **147** has its outer periphery secured to the tube group **131** and is formed with the central opening **148** for receiving a pump for circulating the heat transfer liquid according to the principles described in connection with the previous embodiments.

In the embodiment of FIGS. 12 and 13, a heat exchanger **150** comprises a tubular element of rectangular cross section arranged in a spiral coil from an inlet end connected with inlet fitting **151** to an outlet end connected with an outlet fitting **152**. Adjacent turns of the coil abut, so that the heat exchanger effectively provides a baffle corresponding to that provided at **42** in FIG. 1. At the same time, the coiled conduit provides for flow of fluid to be heated longitudinally and circumferentially through the heater in heat exchange relationship with the heat transfer fluid. At the right end as viewed in FIG. 12, an annular baffle **155** has its outer periphery secured to the coiled conduit and is provided with a central opening as at **156** for receiving a pump to circulate heat transfer fluid according to the principles described in connection with the preceding embodiments.

I claim:

In a compact heater for viscous fluids which tend to decompose when heated in direct fired heaters, a generally cylindrical outer shell of relatively large diameter, a generally cylindrical furnace tube of relatively large diameter centrally disposed in the outer shell and spaced therefrom thereby providing a relatively thin annular space around the furnace in the shell for heat transfer liquid, a hot gas flue connected to the furnace tube adjacent one end thereof and closely spirally encircling the furnace tube to the other end thereof, conduit means encircling the furnace tube and spaced from the outer shell, said conduit means defining a substantially cylindrical baffle closely encircling the flue and extending substantially from end to end of the shell, passage means at opposed ends of the conduit means for providing a closed circulation path for the heat transfer liquid extending longitudinally substantially the entire length of the shell in one direction inside the baffle and in the opposite direction outside the baffle, a plurality of tubes positioned between the outside of the baffle and the outer shell, said tubes extending from substantially one end to the other of said baffle and being immersed throughout their length in the heat exchange fluid passing in said opposite direction, means for passing the fluid to be heated through said tubes, and means for circulating heat transfer liquid through one of said passage means for flow inside said baffle means and through the other passage means for circulation outside the baffle means and return to said one passage means to pass said heat transfer liquid in heat exchange relationship with the furnace tube, the flue, and said tubes, at a velocity sufficient to prevent decomposition of the fluid being heated.

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